

An aerial photograph of a suburban residential area. The image shows a mix of single-family homes with varying roof colors (grey, brown, white) and green lawns. A winding asphalt road cuts through the center of the neighborhood. In the background, there are more houses and a line of trees under a clear sky. The overall scene depicts a typical New Jersey suburban watershed.

# Characterizing Two New Jersey Watersheds

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John Reiser

Rowan University







Scale 1: 7,301,669

41,267.93  
1,094,970.81

VIEW 1

new\_res\_gis.shp

☐ Stmun.shp

☒ Huc11.shp

☐ Protected

☐ Newurb95

☒ Imperv

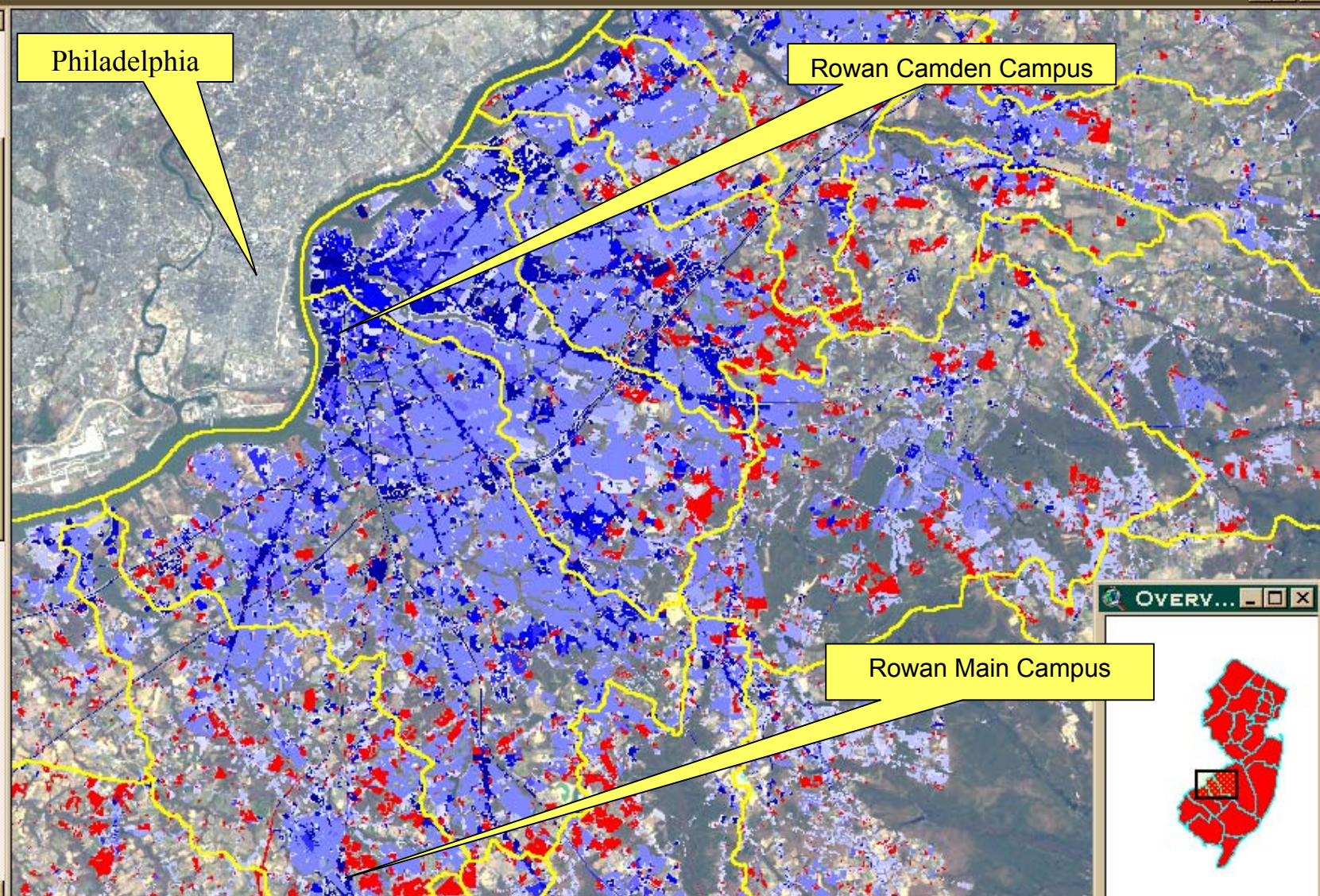
☐ Available

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No Data

0  
1  
No Data

1 - 5  
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11 - 15  
16 - 20  
21 - 25  
26 - 30  
31 - 35  
36 - 40  
41 - 45  
46 - 50  
51 - 55  
56 - 60  
61 - 65  
66 - 70  
71 - 75  
76 - 80  
81 - 85  
86 - 90  
91 - 95  
96 - 100  
0

0  
1  
No Data



OVERVIEW...



# NJ's Sustainable Future

- 11 goals
  - promoting economic vitality
  - public health
  - social equity
  - efficient land use
  - protecting ecological integrity
  - natural resources
  - etc.

# Development of Indicators in NJ

- 41 statewide indicators (NJ Future, 2000)
  - income levels
  - high school graduation rates
  - beach closings
  - vehicle miles traveled
  - air pollution
  - etc.....
- 3 indicators deal with land use
  - freshwater wetland loss
  - farmland loss
  - preserved vs. developed land



# Watershed-based Management

## NJDEP

- stressor-condition-response model
- coupled to adaptive management measures
- key issue areas -land, natural resources, and water
- ex. —
  - net increase in wetlands quantity
  - no net loss of forested

# Impervious Surface as Keystone Indicator

- indicator of the intensity of urban/built-up land use due to its relationship to water quality (Kaplan and Ayers, 2000).
- *I.S.* coverage related to changes in alkalinity, nutrient loading and chemical contamination (Alley & Veenhuis 1983; Horner, Booth, Azous, & May 1996; Booth & Jackson 1997).
- a primary environmental indicator for effective land planning (Brabec et. al. 2002).
- thresholds of coverage related water quality conditions (Arnold & Gibbons 1996)
  - 10% impacted
  - 30% degraded





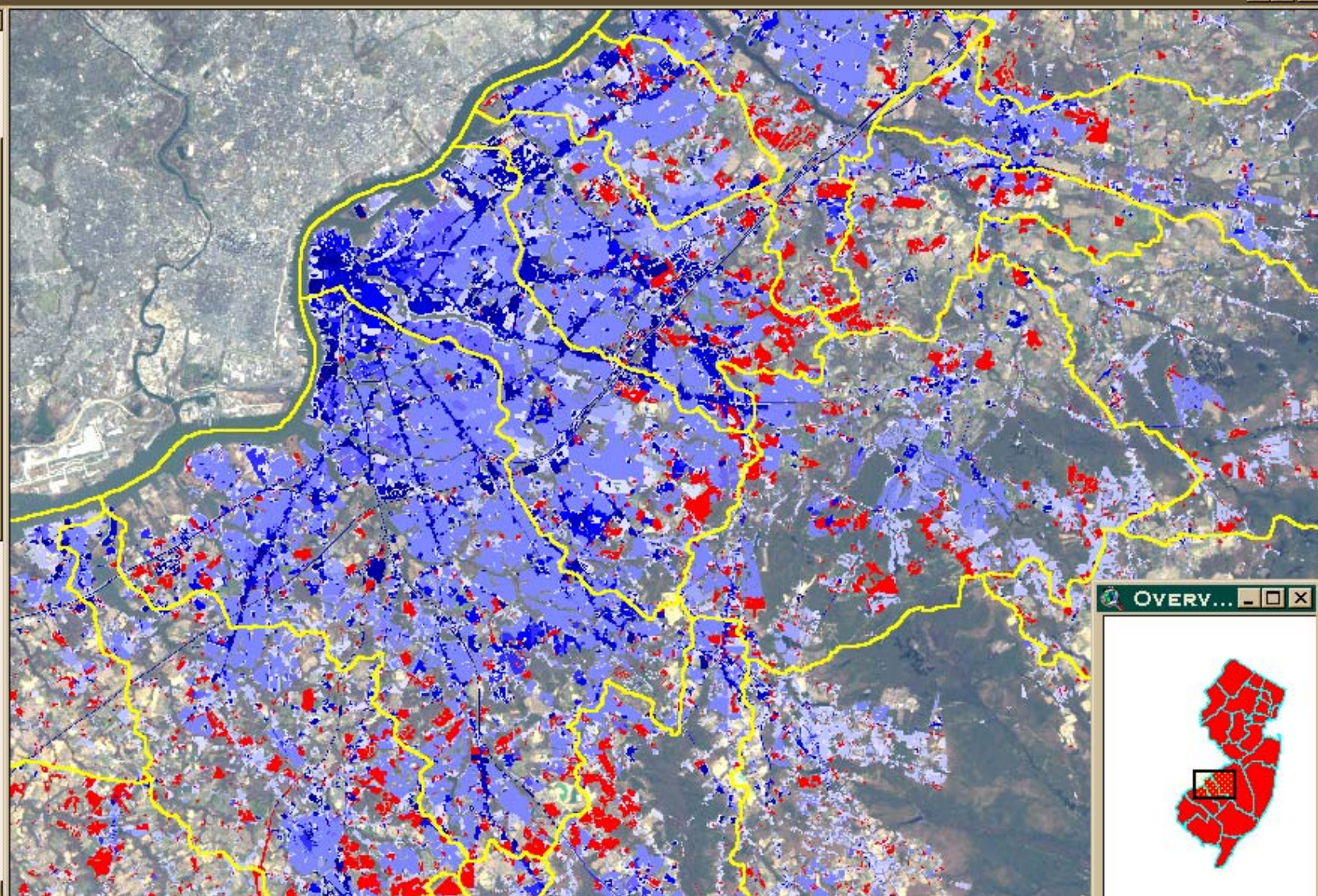
Scale 1: 7,301,669

41,267.93  
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VIEW 1

Legend for View 1:

- ☐ new\_res\_gi... (Red dot)
- ☐ Stmun.shp (Yellow outline)
- ☒ Huc11.shp (Yellow outline)
- ☐ Protected
  - 0 (White)
  - 1 (Green)
  - No Data (Black)
- ☒ Newurb95
  - 0 (White)
  - 1 (Red)
  - No Data (Black)
- ☒ Imperv
  - 1 - 5 (Lightest Blue)
  - 6 - 10
  - 11 - 15
  - 16 - 20
  - 21 - 25
  - 26 - 30
  - 31 - 35
  - 36 - 40
  - 41 - 45
  - 46 - 50
  - 51 - 55
  - 56 - 60
  - 61 - 65
  - 66 - 70
  - 71 - 75
  - 76 - 80
  - 81 - 85
  - 86 - 90
  - 91 - 95
  - 96 - 100 (Darkest Blue)
  - 0 (White)
- ☐ Available
  - 0 (White)
  - 1 (Yellow)
  - No Data (Black)

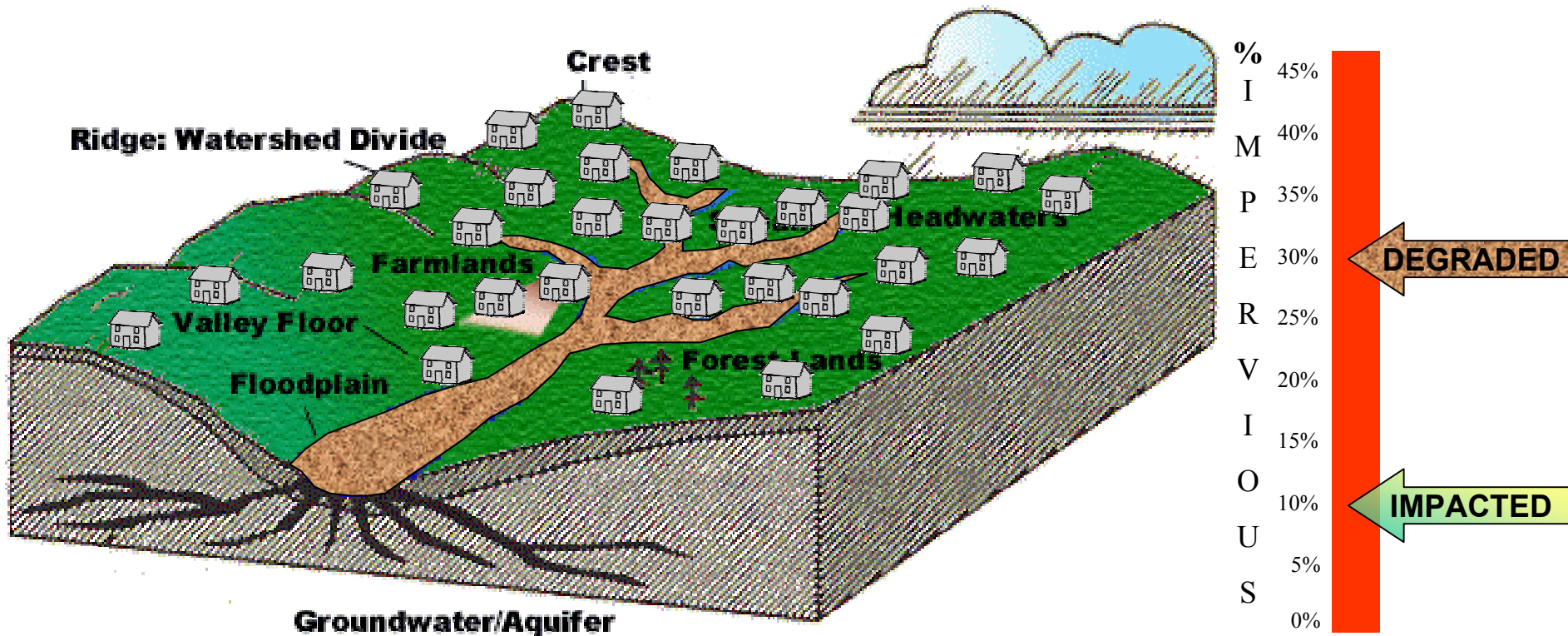




# Impervious Surface (11 ff/day)



# Hydrological Function of a Watershed





# Developing Four Watershed Indicators

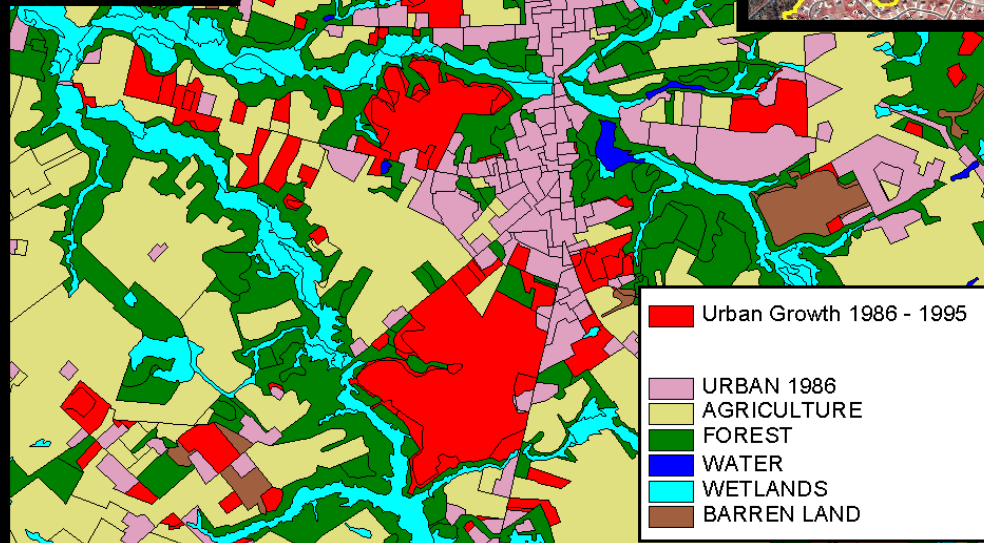
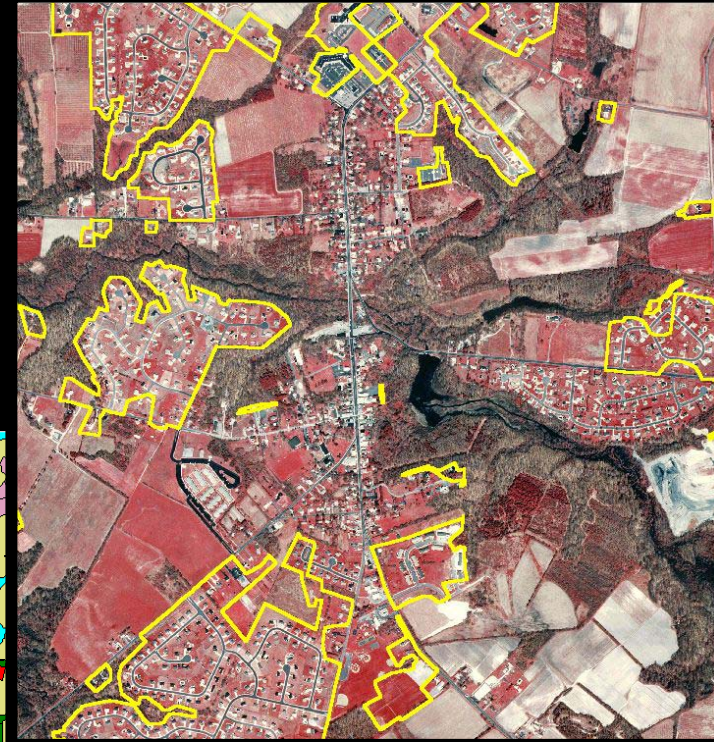
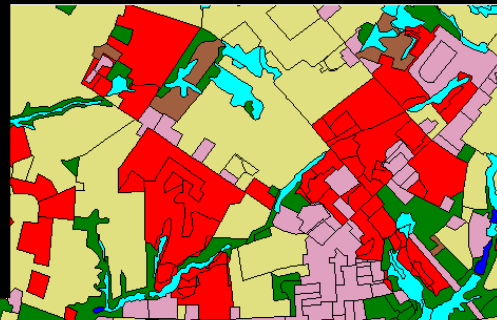
- Land Utilization and Change Profile
- Percent Impervious Surface
- Percent Impervious Surface Increase
- Urban Intensity Index

# Data

- LU/LC 1986 (Time 1)
- 1995/1997 (Time 2)
- impervious surface coverage estimates
- over 50 categories of classes
- modified Anderson level II-III
- delineated from 1986 orthophotoquads.
- updated to 1995/97 and enhanced in spatial accuracy through “heads-up” on-screen digitizing
- 1-meter grid cell resolution.
- accuracy of + - 60 feet (18.29m)
- minimum mapping unit of 1-acre (0.4047 ha)
- freely available at the NJDEP website ([www.state.nj.us/dep/gis](http://www.state.nj.us/dep/gis)).



# NJ DEP LULC dataset



# Indicator #1 Land Utilization and Change Profile



■ Chestnut 1986
 ■ Chestnut 1995
 ■ Newton 1986
 ■ Newton 1995

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%



0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

RESIDENTIAL, HIGH DENSITY, MULTIPLE DWELLING  
RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY  
RESIDENTIAL, SINGLE UNIT, LOW DENSITY  
RESIDENTIAL, RURAL, SINGLE UNIT  
COMMERCIAL/SERVICES  
INDUSTRIAL  
TRANSPORTATION/COMMUNICATIONS/UTILITIES  
MIXED URBAN OR BUILT-UP LAND  
OTHER URBAN OR BUILT-UP LAND  
MANAGED WETLAND IN MAINTAINED LAWN  
GREENSPACE  
RECREATIONAL LAND  
ATHLETIC FIELDS (SCHOOLS)

Detailed Level II  
Description for urban

Total Urban

Total Agriculture

Total Forest

Total Water

Total Wetlands

Total Barren

General Level I  
Description for all land uses



■ Newton  
1986 ■ Newton  
1995

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

RESIDENTIAL, HIGH DENSITY, MULTIPLE  
DWELLING  
RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY  
RESIDENTIAL, SINGLE UNIT, LOW DENSITY  
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Description for all land uses



**Chestnut**  
**1995**

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

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RECREATIONAL LAND  
ATHLETIC FIELDS (SCHOOLS)

**Detailed Level II  
Description for urban**

-----

Total Urban  
  
Total Agriculture  
  
Total Forest  
  
Total Water  
  
Total Wetlands  
  
Total Barren

**General Level I  
Description for all land uses**

Chestnut

1986

Chestnut

1995

0%10%20%30%40%50%60%70%80%90%

RESIDENTIAL, HIGH DENSITY, MULTIPLE DWELLING

RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY

RESIDENTIAL, SINGLE UNIT, LOW DENSITY

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TRANSPORTATION/COMMUNICATIONS/UTILITIES

MIXED URBAN OR BUILT-UP LAND

OTHER URBAN OR BUILT-UP LAND

MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE

RECREATIONAL LAND

ATHLETIC FIELDS (SCHOOLS)

Detailed Level II  
Description for urban



Total Urban

Total Agriculture

Total Forest

Total Water

Total Wetlands

Total Barren

General Level I  
Description for all land uses

■ Chestnut  
1995

■ Newton  
1995

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

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RECREATIONAL LAND  
ATHLETIC FIELDS (SCHOOLS)

Detailed Level II  
Description for urban

Total Urban

Total Agriculture

Total Forest

Total Water

Total Wetlands

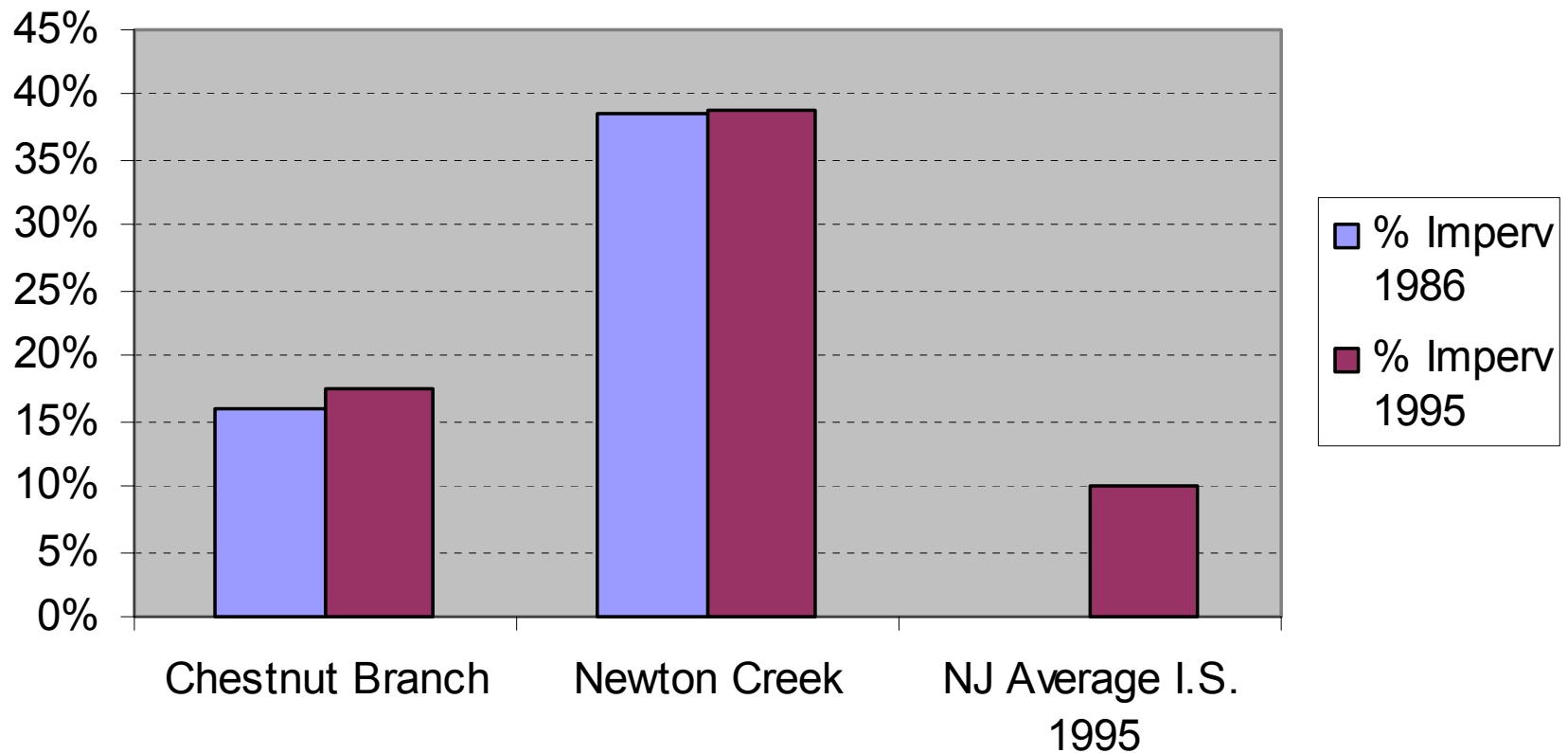
Total Barren

General Level I  
Description for all land uses



# Indicator #2 Percent Impervious Cover

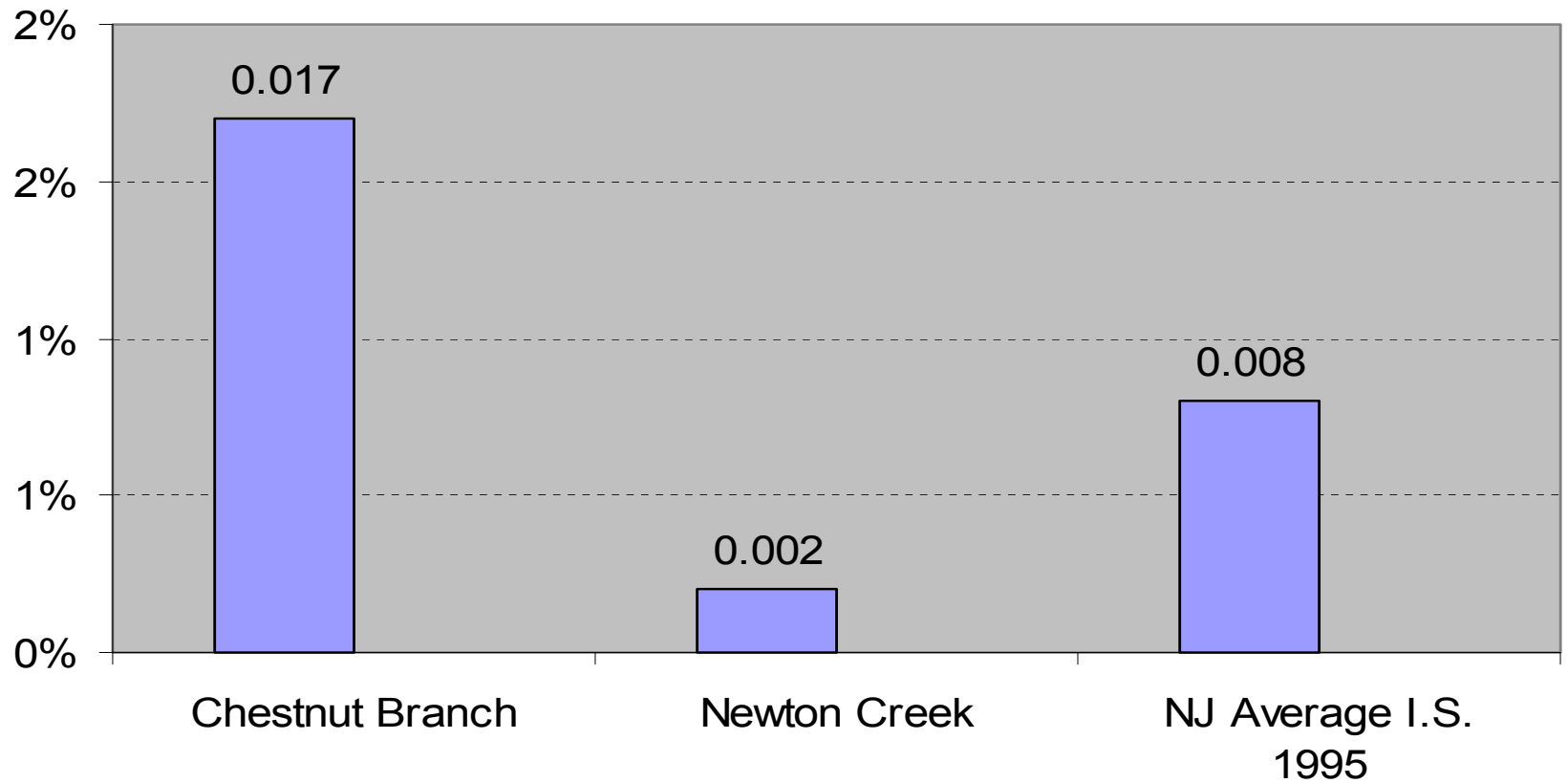
# Percent Impervious Surface Coverage



# Indicator #3 Percent Impervious Cover Increase



# Percent Impervious Surface Increase



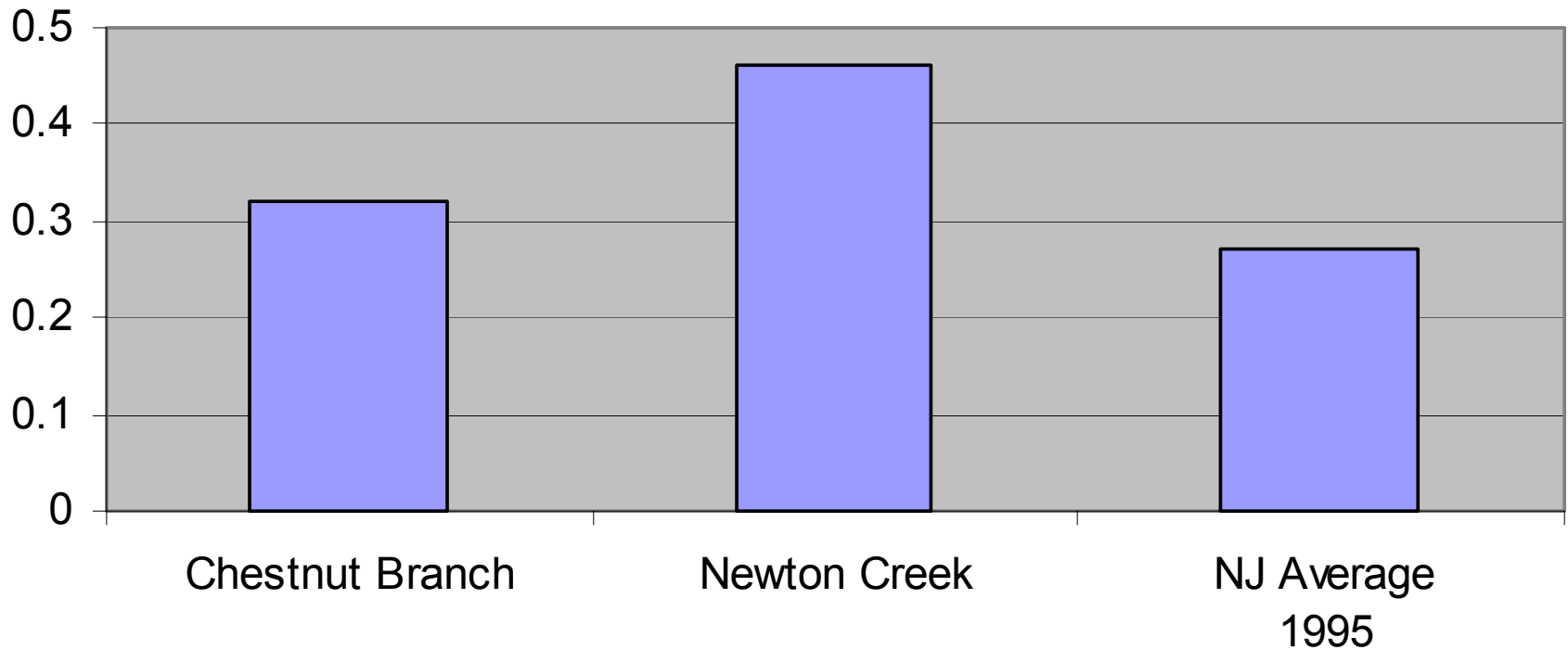
# Indicator #4 Urban Intensity Index

- percent impervious surface normalized by the percent urban

$$UI = \frac{Pct\_IS}{Pct\_urb}$$

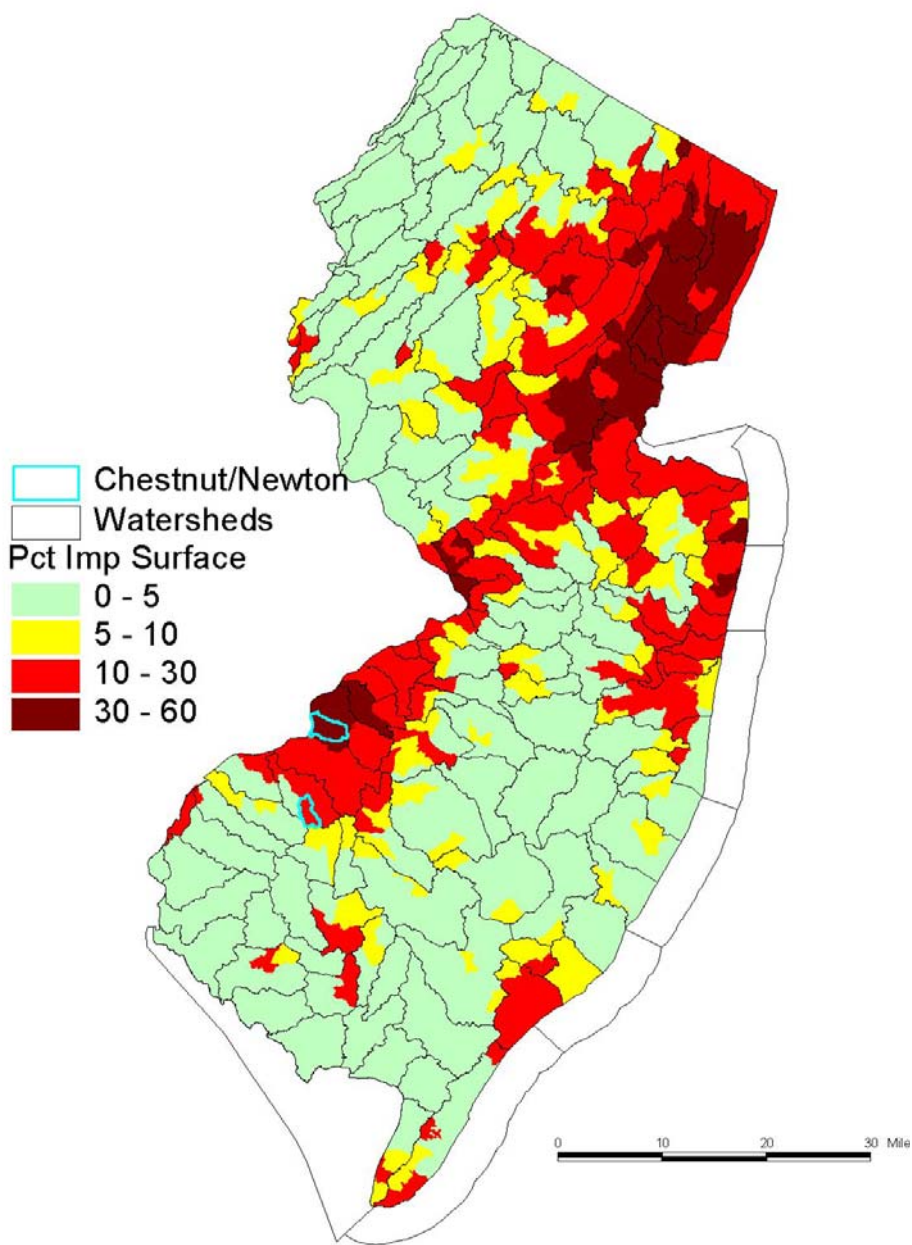
# Urban Intensity Index

Urban Intensity

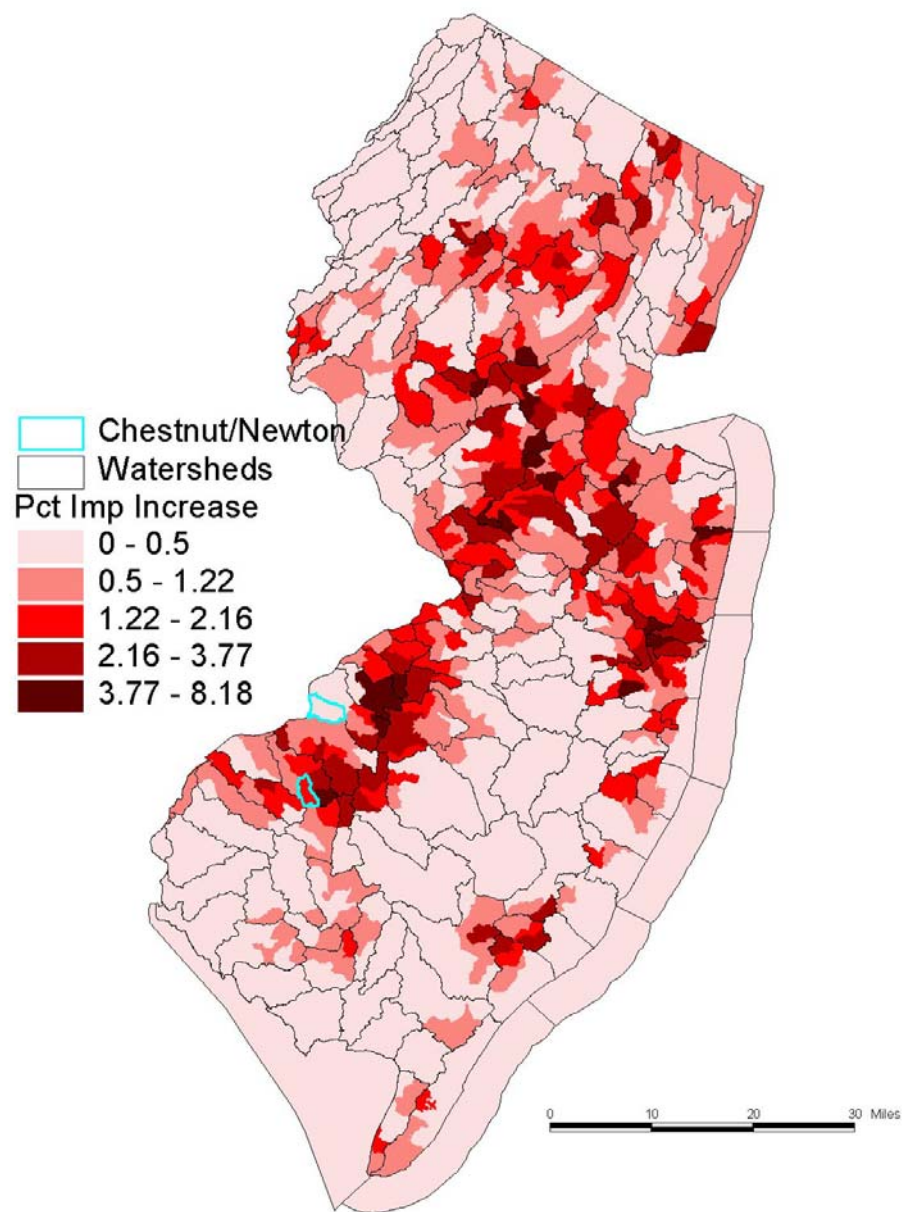




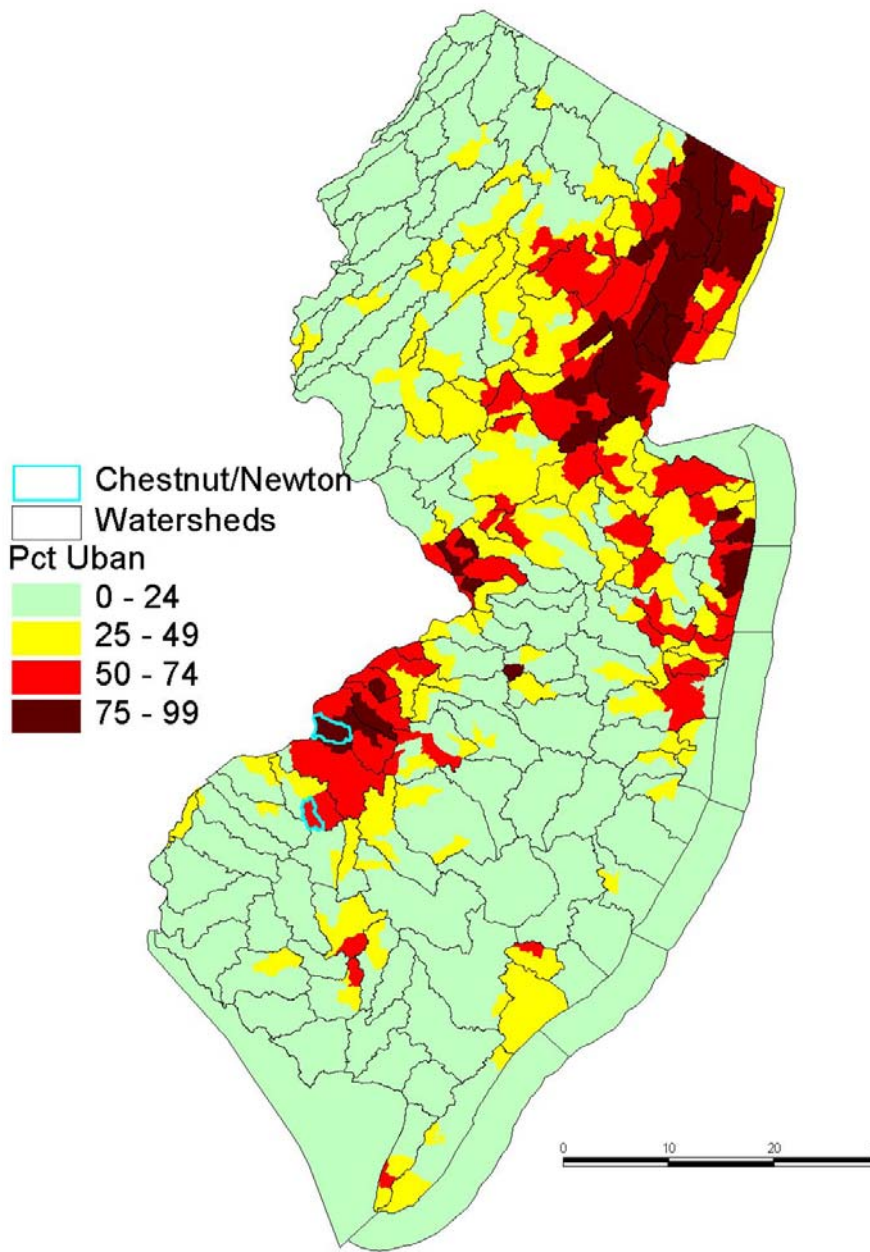
# Statewide Ranking



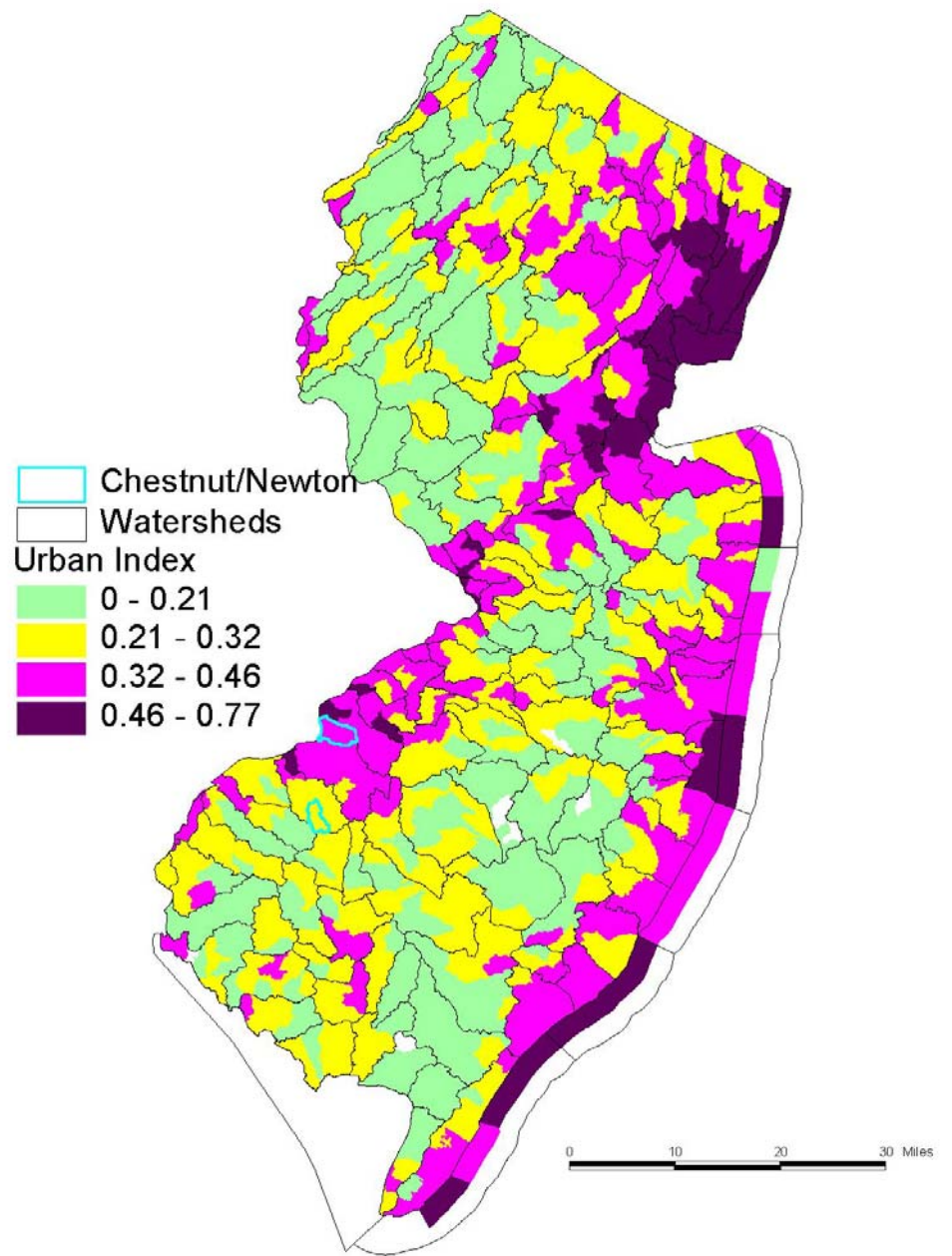
Percent Impervious Surface by  
Sub-watershed



Percent Impervious Surface Increase  
by Sub-watershed



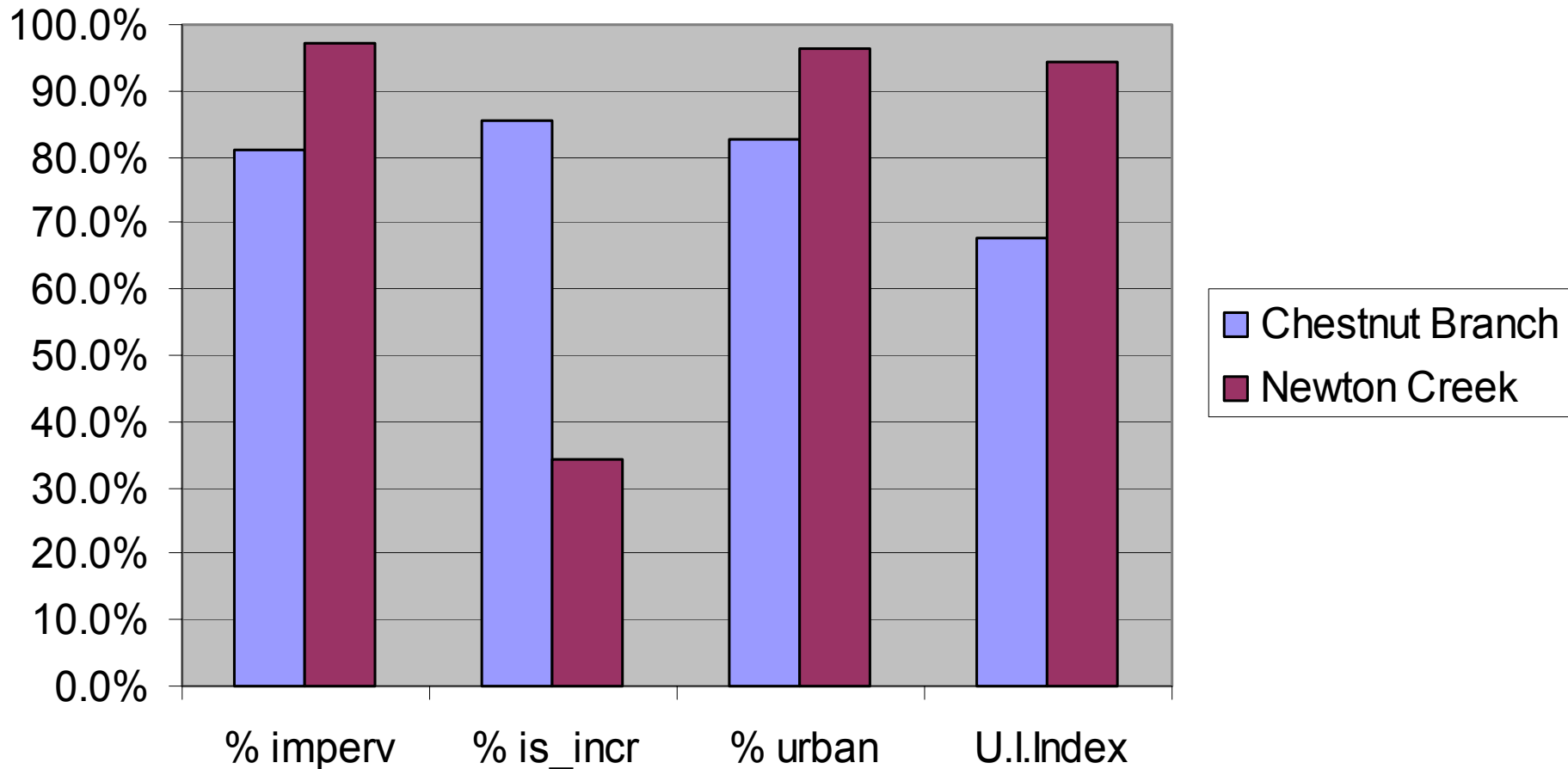
Percent Urban by  
Sub-watershed



Urban Intensity Index  
by Sub-watershed



# Statewide Percentile Rank



# Summary

what does each indicator do?  
what information do they provide?

1. Land Utilization and Change Profile
2. Percent Impervious Surface
3. Percent Impervious Surface Increase
4. Urban Intensity Index

# Conclusions

- Preliminary study – only 2 of New Jersey's 899 sub watersheds.
- progress for watershed indicators
  - Evaluation
  - Comparison
  - Characterization
- Combined, the four indicators provided a robust description and characterization of the current and dynamic conditions of watersheds.
- Future development
  - standard system of classification for characterizing watershed
  - explore cluster analysis and principle component
  - development of these indicators into a "Claritas"-like categorization system
- Indicators supporting land use policy and management decision making, protecting water quality, mitigating sprawl, fostering smart growth and encouraging revitalization of already developed areas.